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Total Quality Management : a management philosophy for providing high quality construction

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TOTAL QUALITY MANAGEMENT

A Management Philosophy for Providing High Quality Construction

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ABSTRACT

Total Quality Management (TQM) is not a new concept. However, its use in my construction company is. Only recently (within the past ten years or so) have American companies started to realize the potential of TQM as a means of ensuring high quality products and services. With this realization has come implementation in manufacturing and service companies.

A commercial construction company, like any other business, must provide a top quality finished product to its customer if it intends to stay in business. TQM is one way to work to that end. This report explores the quality problems facing my fictitious construction company, which I believe are fairly typical among the commercial construction industry, existing management methods, and the TQM method to ensure top quality production.

It will be shown why I believe TQM or a variation thereof is the best method for controlling the quality of products and service during the construction process. Under the philosophy of TQM, we build quality into the finished product.

OBJECTIVE

Total Quality Management is a management philosophy that is enjoying a great deal of notoriety these days. Its emphasis on the importance of customer satisfaction, continuous improvement, and problem prevention is catching the attention of many companies. The guiding principles of TQM does not concern themselves with any particular type of application and should therefore be applicable to any type of business.

The objective of this report is to focus on the TQM philosophy as a means of solving the construction quality problems facing my commercial construction operations.

INTRODUCTION

One of the problems facing my construction company is a seeming lack of cost effective quality control. I believe other contractors experience similar problems. All too often defective concrete assemblies need to be repaired or replaced, activities finish late causing a delay to the project, assemblies fail inspection which requires rework, poor quality construction leads to premature failure of subassemblies like roofs or slabs, and improper construction processes and other causes lead to accidents and injuries. Typically we have attempted to control quality through final inspection. These inspections point out

defective work only after it has been completed. At that point costly labor and materials have already been expended. Expensive rework is then required to bring the construction up to an acceptable level of quality. In reality we have paid to do the work more than twice (we must demolish the non-compliant work before we can rebuild). We intuitively believed it would be better to ensure we do it right the first time and every time. As a result, we began to wonder whether there was an existing management style or technique that would move us toward that goal? We learned Total Quality Management can do just that.

TQM is the only management system that focuses on the product and systematically builds quality into every product or service a company provides. Effective employment of the TQM philosophy and its variations is what makes a Honda one of the most trouble-free automobiles in the world. It is also noteworthy that Honda also maintains one of the highest levels of owner loyalty. Honda owners keep going back to buy Hondas again and again because they like them and they work. Typical building owners and developers do not go buy a new building every three or four years, but imagine the business potential for the construction company that commands that degree of customer loyalty. TQM focuses on customer satisfaction and will ultimately lead to lower production costs, increased profits, and repeat sales.

To date most implementations of TQM have been in the manufacturing arena. Some would argue that TQM is not appropriate for a service industry such as construction. We believe that is a misguided belief. We will see that it is not only applicable, but also why, and how we should implement TQM in a construction company.

WHAT IS THE PROBLEM?

Our problem, which I believe also faces other commercial construction companies, is: How to construct a high quality finished product that satisfies the needs of the owner (our customer) at a cost effective price that ensures we remain in business. To solve such a problem is difficult since the various goals often seem to be inconsistent with one another. High quality is usually synonymous with high cost. Low quality usually results in owner dissatisfaction. The owner wants to spend the least amount possible for the highest quality end product. How do we provide high quality at the lowest cost particularly in a time of extensive competition? Our specific problem is that a seeming lack of comprehensive quality control is costing us time and money. We feel that effective implementation of TQM will provide the means of meeting these conflicting goals.

Background

We are a mid-sized commercial contractor involved in both private and government work. We bill about $6 million worth of work in place per year. All project management staff are our employees and we usually perform about sixty percent of the work with our own labor. For the past three years we have had to provide a Contractor Quality Control (CQC) representative on at least one government job per year.

Specific Problem

Historically we have experienced real costs associated with lack of quality control amounting to about three percent of project costs. That amounts to nearly $180,000 per year spent to correct quality failures. These costs have primarily resulted from rework. Typical failures would include such things as a void in a concrete wall, leaking roofs, out of plumb structural members, material cost overruns due to waste, accidents, and poor equipment production rates. This list is by no means all-inclusive but rather is intended to be illustrative.

Causes

Most of the problem causes seem to be rooted in either a lack of training or procedure. For instance concrete voids and segregation problems have resulted from improper vibration, hot concrete, or dropping the concrete. Such a situation involves both lack of training (on the part of the vibrator operator) as

well as lack of an effective procedure. The crew foreman should be checking the height of the concrete drop, the batch time of the concrete prior to placing it, and should be ensuring the vibrators are operated properly.

RESEARCH METHODOLOGY

The approach utilized to research the problem of controlling the quality of construction products and services and the adaptation of TQM to my construction company consisted of three phases. The first phase of research consisted of a text review. I explored various texts to get the basic understanding of the assorted management techniques as well as the fundamentals and principles of TQM and its diverse adaptations. Next I reviewed journal articles covering all aspects of TQM implementation and applicability to construction and engineering. The third and final phase consisted of an interview with representatives from a national construction company actively engaged in implementation of a Strategic Quality Management process[1].

[1] "Strategic Quality Management" is the terminology utilized by the Ryland Group, Inc. to describe their quality control efforts that incorporate customer satisfaction concerns into every business decision.

DISCUSSION

ALTERNATIVE METHODS

In the beginning there was the whip. Workers were often motivated to "work harder" and "do better" by fear of actual physical and emotional pain. Sadly, examples of that management style, or variations thereof, are still used today. We have never used those techniques but have tried encouraging employees to work harder and do better. Fortunately we realized from the beginning that workers motivated by the simple fear of losing their jobs are little concerned with providing a top quality product or service. What motivation they have stems from a fear of doing it wrong rather than an interest in doing it right.

Fortunately other management techniques have evolved. Perhaps the first of these was Scientific Management which focused on using labor more effectively. Under Scientific Management we determine the one best way to perform the work, the optimum pace, provide training to perform the task, and reward successful performance through pay. The Behavioral Approach is another management technique. This management method focuses on the realization that managers must get work accomplished through others. Hence managers are concerned with the work behavior of their subordinates and what motivates them as individuals to perform work. The Management Science approach, yet another

method, utilizes mathematics and statistical tools to aid in solving production and operating problems (Ivancevich, 1989).

Along with these management techniques come all the motivation theories. That is; how can a manager start, direct, and maintain physical performance. These include such things as Needs Theory, Achievement Motivation Theory, Two Factor Theory, Expectancy Theory, and the Reinforcement Theory. As a group, these are approaches which attempt to maximize the performance of individual workers through motivation (Ivancevich, 1989).

To attempt to increase worker motivation we tried implementing Quality of Work Life (QWL) programs. They were geared toward improving productivity through greater work involvement and increased job satisfaction. Perhaps the most closely related QWL program to the issue at hand are Quality Circles (QCs). Unfortunately though, we implemented QCs with the focus on increasing the feeling of involvement and participation in the decision making process rather than on quality improvement through process refinement. In addition, our project managers and superintendents were not ready for participative management. They seemed to feel threatened by workers who had better ideas on how to do the work than they did and consequently never acted on the suggestions. After about six months there was no enthusiasm for QCs whatsoever. During the period after the QCs died, we suffered some of the lowest company moral I've ever experienced.

For the most part, the aforementioned management techniques narrowly focus on only one aspect of the management issue and fail to even mention the importance of quality or the customer. Some techniques focus on work methods while others focus on worker enthusiasm and motivation. We discovered, however, TQM is an all-encompassing management philosophy that focuses on continuously improving customer satisfaction through employee involvement and process control. We also felt that to successfully implement TQM requires addressing all the issues studied by the aforementioned management techniques. In other words, work definition and worker enthusiasm and motivation all need to be addresses to effectively implement TQM. It recognizes the importance of employees satisfaction, and stresses participative management and employee empowerment. TQM stresses simplification and continuous improvement of the process. Employee motivation and work definition are both important parts of the TQM system. For those reasons, TQM seems to be the most appropriate management technique for construction companies today.

WHAT IS TOTAL QUALITY MANAGEMENT?

According to the DOD Total Quality Management Guide (5000.51-G), "Total Quality Management (TQM) is both a philosophy and a set of guiding principles that represent the foundation of a continuously improving organization. TQM is the application of

quantitative methods and human resources to improve the materials and services supplied to an organization, all the processes within an organization, and the degree to which the needs of the customer are met, now and in the future. TQM integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach focused on continuous improvement."

The TQM philosophy can be broken down into three fundamental concepts. The first is a focus on the customer, both internal and external. The second is the idea of continual improvement forever. No matter how much improvement you make there is still room for more. The third concept is to focus on problem prevention instead of problem solving (Simon, 1991). Fighting fires is a wasteful approach to problem resolution. Building a fire prevention system is a much more effective system.

As developed by Dr. Demming, TQM consists of fourteen points, seven deadly diseases, and some obstacles. A simple listing of those points are as follows:

Point 1. Create constancy of purpose for improvement of product and service.

Point 2. Adopt the new philosophy.

Point 3. Cease dependence on mass inspection.

Point 4. End the practice of awarding business on price tag alone.

Point 5. Improve constantly and forever the system of production and service.

Point 6. Institute training.

Point 7. Institute leadership.

Point 8. Drive out fear.

Point 9. Break down barriers between staff areas.

Point 10. Eliminate slogans, exhortations, and targets for the workforce.

Point 11. Eliminate numerical quotas.

Point 12. Remove barriers to pride in workmanship.

Point 13. Institute a vigorous program of education and retraining.

Point 14. Take action and accomplish the transformation.

These points are fully described by Dr. Demming and M. Walton and nearly every other text that addresses TQM along with the deadly diseases and obstacles. They are mentioned here for ready reference purposes only.

WHY IMPLEMENT TQM

Unlike the automobile industry, the construction industry in the United States has yet to experience substantial competition from foreign constructions firms. However, we do feel substantial competition from local American firms. They are reducing bids by cutting profit margins and other tactics in the hopes of winning the few jobs being offered. We have found our quality problems increase when we try cutting corners in an effort to be more

competitive. That has resulted in a double whammy; increased corrective costs as well as reduced profits. We are concerned that the long term effects of reduced quality, whether through rework, latent defects, communication difficulties, customer complaints, late delivery, increased litigation associated with claims, or simply damaged reputation may ultimately drive us out of business.

We engage in TQM in order to manufacture products that meet or exceed the quality requirements of the customer (Ishikawa, 1985). Effectively implemented, the TQM philosophy will improve corporate health and the character of the company. It leads to the establishment of a management system that can secure profits even in times of slow growth while providing job security and a fulfilling and stimulating work environment. TQM stresses respect for fellow workers and nurturing of the human resource which leads to greater job satisfaction and productivity. Together these benefits should ensure the continued profitable operation of the company.

Benefits

With effective implementation of TQM comes improved company moral and a company-wide spirit of teamwork. Perhaps more importantly comes a heightened sensitivity to the market and customers. This increased sensitivity and team spirit makes it possible to build quality into every step of the construction process and to ensure

defect-free production. It is not just enough to find defects and flaws and correct them after the fact. It is essential to determine the cause of the construction defects. Once the cause is determined and corrective measures are instituted, future defects can be prevented (Ishikawa, 1985). Hence quality is built-in. TQC helps workers locate and identify the defect causes. The TQM philosophy opens channels of communication within companies that permit ready defect detection and correction. TQM enhances the companies ability to discover potential failures before they turn into disasters because everyone is used to talking to one another truthfully. In a very real sense, the TQM philosophy fosters an environment for probing minds that seek out causes of failure and can determine appropriate corrective measures.

COST

Before we go too far in our discussion of the merits of TQM and its implementation as a management system, we need to address the issue of cost. It goes without saying that no matter how high the quality, if the product is overpriced it will not gain customer support. No one will buy it. For our purposes it is appropriate to realize that we cannot define quality or a quality control system without consideration for cost. There can be no quality control that ignores price, profit, and cost control. In

other words, regardless of what type of quality control system we institute, we need to be sensitive to the cost of that system.

It is important however that we recognize what we are truly talking about when we refer to the "cost of quality". In most cases the "cost of quality" is really the "cost of low quality". The expense associated with producing defective work is a cost of low quality. Defective work that is discovered at the end of the project by inspection has to be corrected. In such a case, the lack of quality has cost rework as well as the cost associated with performing the work incorrectly in the first place. As mentioned previously, we determined that our low quality costs amounted to about $180,000 per year. If quality is build into the production process, there would be no defective work, no scrap, and no need for inspectors.

The implementation of TQM will cost money. It costs money to establish steering committees and quality circles. There are appraisal costs, costs of inspection, quality audits, and the cost of overseeing the TQM development program. These are the costs associated with defining, creating, and controlling quality, as well as the monitoring of conformance to the quality standards (Sugg, 1991). Hopefully these costs lead to the elimination of defective products, and increased efficiency in performing every process throughout the business. We are

reducing failure cost by investing in ways to effectively control the process to produce a high quality product every time.

In actuality, while the implementation of quality control programs represents an expense, the resulting production of high quality products pays. According to the research of the Strategic Planning Institute, companies that produce products perceived as high quality by their customers enjoy a larger market share and higher profits than those companies who do not (Sugg, 1991).

WE ARE BEHIND BEFORE WE START (Japan does it better)

For American management to engage in the concept of TQM now is almost like starting a football game after half-time. Our competitors have been running with the ball for two quarters while we stood by the side line and watched. It is not fair to say that we have just been standing still. However, it is fair to say that the perception of the quality of American products has been declining. The longer we wait to revitalize the quality spirit the more difficult it will be. After all, the Japanese have been working at TQM and its various offspring philosophies for forty years. They are not going to take a time out while we try to catch up. As mentioned previously, the construction industry so far has been relatively insulated from foreign

competition. But with advances in technology, like robotics applications for construction, being pursued by other countries, it seems only a matter of time before foreign construction firms are successfully bidding work in our own backyard.

IMPLEMENTATION

We realized that once we decided to embark on the implementation of TQM perhaps the most important thing we had to keep in mind was that it would not be an instant fix. Successful implementation of TQM takes time and lots of it. As one of the guiding principles states, "continuous improvement forever". TQM is of itself nothing more than another management system. The heart of TQM, the three basic principles further outlined by the fourteen points, involves a new way of thinking that is usually quite different from previous experience. Conversion to the TQM management philosophy requires a tremendous effort that many companies are unwilling to expend. It involved giving up the way we conceived of things in the past and replacing that with a more logical and simplistic way of quality production. We learned to build quality into a product rather than inspect out bad quality.

While the Demming methods of TQM are universally applicable, they cannot simply be superimposed on your organization (Walton, 1986). The guiding principles are much the same, but the methods of quality production of an automobile manufacturer or electric

utility will be different from those of a commercial construction company. Hence, every application is unique. Each company must develop its own approach to the implementation of TQM and stick to it. Adjustments will, of course, be necessary as learning takes place and suppliers and customers start to understand your new way of doing business.

Support From The Top

Absolutely essential to the successful implementation of TQM is the unwavering commitment of top management. Only top management can create and foster an atmosphere that encourages innovation, pushes down problem solving responsibility, and accepts mistakes. Our first step (in accordance with Walton's recommendations) was to establish a TQM steering committee to develop the initial goals for the TQM application. Top management, along with the steering committee, is working to develop a critical mass of TQM support within the organization. This critical mass will be the core of support for initial TQM efforts and will demonstrate by example the benefits of the new way.

This principle of top management support has been instrumental to the success of the Japanese TQM efforts. The Japanese have insisted on the participation by all, from the CEO to the line worker. They realized early on that only top management could instill the company-wide total quality atmosphere required to make it work (Ishikawa, 1985). Too often the QC efforts in U.S.

companies like ours have been delegated down to QC specialists or consultants who lack the authority, vision, and leadership capabilities of the chief executive. Without the commitment of top management, the TQM effort will fail.

The Ryland Group, a national residential home builder and mortgage finance company, first explored the implementation of TQM about five years ago. The new philosophy was brought into the company by consultants hired by the Chief Executive at the time. Initial TQM efforts brought quality circles and other TQM activities but failed. The failure resulted from management being ill-prepared to handle the output of the quality groups, the CEO's lack of a complete understanding of TQM, and his failure to spearhead the implementation process. The workers involved in quality circles saw the lack of management support for TQM efforts and quickly lost interest. When that CEO retired he was replaced by a senior Vice President from General Electric who brought with him a thorough understanding of the TQM philosophy and the difficulties and benefits of implementation. Under his leadership, Ryland has adapted the TQM philosophy to suit their own particular needs and is aggressively moving forward with its implementation.

Commitment of Management

As previously stated, Dr. Demming realized that top management must be committed to the TQM effort for it to succeed. Part of

that commitment means to take responsibility for their own actions. Dr. Demming believes that 85% of all production and quality problems are the fault of management (Walton, 1986). When things go wrong, we managers must be willing to take responsibility. An important example of this is the bead experiment (Walton, 1986). The bead experiment illustrates how management holds workers to quality and productivity specifications which are impossible while at the same time illustrating that variation is part of every process. It is futile and disheartening for managers to tell workers to increase quality or productivity within an out of control system without providing them the tools or training needed.

One of the biggest problems we face, especially during the implementation phase of TQM, is convincing workers that management is serious. Two of the biggest indicators of seriousness are time and money. How much of the our time is dedicated to the quality effort? Is management committing money to training and implementation that is required to support TQM implementation? The typical worker has been around long enough to tell by our actions whether or not TQM will be just another temporary management fling like Management By Objective or Zero Defects.

To be effective management needs to have a thorough understanding of TQM ahead of everyone else in the company. We need to be

familiar with all the issues involved and how other companies (particularly the Japanese) have implemented TQM effectively. Only then can we custom tailor our companies approach to quality (Ishikawa, 1985). More than any one else in the company, management needs to go through a thought revolution process. Management needs to think in the following way to make TQM successful; first, we need to realize the importance of the happiness of the people connected with us. If people are not happy in their work, they will not produce. Second, quality drives everything. Producing poor quality products will drive us out of business. Third, the customer is the reason we are in business. Without them there is no business. That is not to say that the customer is necessarily always right, but that the needs of the customer are. The Ryland Group places all their focus on the concerns of the external customer. They make decisions based on whether or not the particular action or revised method will be of value to the customer. The customer must be satisfied with the goods and services they buy. Forth, the next process is your customer. This focuses on the important concept of both internal and external customers that will be discussed in greater detail later. Fifth, using facts and data to make decisions. Hunches and gut feelings may be used as a check but are no longer the basis for making important business decisions (Ishikawa, 1985).

Management needs to realize that with TQM comes enlightenment and empowerment of subordinates as well as open channels of

communication that are fostered by the company leadership. New ideas will flow up from workers and quality circles that require action from management. When we fail to act on improvements, they will be criticized and the workers faith in the new way will be harmed. Management may view this as a potential threat but must keep the good of the company in mind and remember that they are all working toward the same goals.

Start Up

One of the toughest hurdles of TQM implementation is getting started. As noted previously, top management needs to be fully committed before the effort starts. Top management along with the steering committee must start looking at ways to tailor the TQM philosophy, within the guidelines of the fourteen points, to their particular company. Ryland does not follow the fourteen points directly, but customized their approach to focus on what adds value to the customer. Once that effort is under way, senior management needs to start putting the TQM approach to work. We followed the 1985 Philadelphia Area Council for Excellence outline of a nine phase approach to TQM implementation. It goes as follows:

Phase One: Education and/or reeducation of top management in the Demming method.

Phase Two: Systematic review of targets of opportunity. target area for improvement and decide how to expend those efforts throughout the company.

Phase Three: Planning for the first project. Pick one that is small and achievable. Set up and educate a team to make it happen.

Phase Four: First project is carried out. Team studies and defines project and reports to steering committee on regular basis.

Phase Five: Other preliminary implementation projects are planned and carried out. Repeat Phases Three and Four for other project.

Phase Six: Top management develops a comprehensive plan, a major escalation, especially in terms of the number of people who will be affected.

Phase Seven: The first large-scale wave of projects is begun.

Phase Eight: Succeeding waves of projects are done.

Phase Nine: Institutionalization. This occurs when all Fourteen Points are the natural way to carry out operations. Constant improvement is a way of life.

Defining Quality and Quality Control (for your industry)

One of the first things that must be done during the start-up stage is to determine what quality means to your company. What is a minimally acceptable level of quality. You need to know where you are now so that you can determine where you can start. This determination can be made by conducting a quality audit. You may utilize the checklist for the Demming prize application, hire a consultant to conduct the audit, or perform a presidential audit (Ishikawa, 1985). We followed Sproles' example of a Self-Audit Checklist which is included as appendix a. Whichever method is utilized, you must determine to what degree your present system assures quality in all products so that a customer can buy them with confidence and use them for a long period of time with confidence and satisfaction.

However defined, quality must be designed into the product or service to be provided and it must be assured through quality control. Quality control is done for the purpose of realizing the quality which conforms to the customer's requirements. To determine what those requirements are we must define what the "true quality characteristics" are for the customer (Ishikawa, 1985). Once we determine the true quality characteristics we can deal with how to measure such characteristics. The specifications may indicate the owner wants one thing or another, but what does final product performance need to be? What is necessary is that the final product be fully functional in the way the customer expects. Our quality control standard should not seek merely to fulfill national standards and company standards, but set to meet the quality requirements of the customer. Effective quality control then "...is to develop, design, produce and service a quality product which is most economical, most useful, and always satisfactory to the consumer" (Ishikawa, 1985).

To buy with confidence a customer must have a sense of trust in a particular product from a particular company that has a record of having provided reliable products for a long period of time. To establish such a reputation is not an overnight process and takes years of dedication to the quality effort. Continuous improvement forever. The only way for that to happen is for everyone in the organization to participate and promote quality

control, including especially top executives, all divisions within the company, and all employees.

To stay abreast of the quality concerns of its customers, Ryland has adopted an aggressive customer survey system. Ryland conducts a comprehensive survey of new home owners at 30 days, 120 days, one year, and soon, three years after closing. These surveys provide Ryland with feedback about what they are doing, right or wrong, as viewed by their customers. They use the results to change designs, materials, or other factors to better suit the needs of their customers. In addition, Ryland surveys consumers who have looked considered a Ryland product but buy from another home builder. This provides insight to what they may not be doing that causes a loss of customers.

Determining Problem

Once you have determined the quality control standard, accessed the current quality levels, and decided on an initial project, you must get down to the business of determining specific problems. Before you can hope to find a remedy you must determine a cause. Remember, TQM involves problem prevention vice problem solving. That means we design problems out of the manufacturing or production process. We want people performing error free work. Here is where statistical methods can be helpful.

System Variability, the Importance of Statistics

The reason for utilizing statistical methods is that making business decisions on assumptions or incomplete information causes trouble. Remember the parable of the red beads? Workers cannot perform the impossible. Even with the same tools, task, and talent output varies. Only proper use of statistical methods brings a process under control.

If we're going to use statistics, we must figure out what to measure. Start with flow charts and cause-and-effect diagrams. Flow charts describe exactly how a process takes place so that everyone understands it. Analysis of the flow chart indicates where problems may take place. We should eliminate any activity in the process flow that does not add value to the process. The cause-and-effect diagram is used to examine factors that may effect a given situation. The effect being the desired or undesired outcome produced by a system of causes (Walton, 1986). From these we can determine what data we need to collect. With the collected data we can prepare a Pareto Chart. The Pareto Chart is used to establish priorities. We naturally want to correct the item or situation causing the most problems or the one that is most frequently contributing to a defect.

A construction example of the use of these methods could be the process of placing a concrete beam. The flow chart describes the entire process, in proper sequence, from ordering the material,

to removing the fins from the completed beam. The cause-and effect diagram may focus on, among other things, cost overruns or delays. For a cause-and effect diagram covering costs, some of the causes producing the undesired outcome of cost overruns may be late materials, material waste, under-productive labor, loose forms, or rework. After data is collected for the occurrence frequency and or associated cost of each of the identified causes, a Pareto Chart can be developed. The Pareto Chart identifies which cause is producing the greatest amount of cost overruns. It may be that late materials is causing fifty percent of all cost overruns. That being the case, we would endeavor to correct the late materials problem first. That correction alone should cut our beam placement cost overruns in half.

The other types of charts typically used in the TQM process are Run (Trend) Charts, Histograms, Control Charts, and Scatter Diagrams. The Run Chart is used to chart data over a period of time to look for trends. For example: the construction time for a "standard" beam form. The Histogram is used to chart the frequency of occurrence. For example: how often is material one, two, three, or more days late. The Scatter Diagram is a method of charting the relationship of two variables. For example: how many days late is form material that is scheduled to be delivered on Monday, Tuesday, Wednesday, and so on. Finally, the Control Chart is simply a run chart with statistically determined upper and lower control limits. This chart illustrates the fact that

all processes contain variation. There are common causes for variation such as machine limitations and worker's ability, but there are also special causes for variation. These could include late materials, an untrained worker, a machine breakdown, or many other factors. Once the special causes have been eliminated and the system has been brought into statistical control, management can begin to address and reduce the common causes and reduce the system variation (Walton, 1986).

Each of these charts or diagrams have special applications that can be employed when needed to help solve a particular problem. But it is very important to realize that use of statistical methods and charting should only be undertaken when the results can be used to add value to the product or for the customer (Wisda & Davis, 1992). Collecting data and making charts for their own sake is wasteful.

Problem Solution

Once a solution for a particular construction problem is determined, it should be standardized to ensure every crew engaged in the same activity is using the same method. The whole point of TQM is to design quality into the construction (manufacturing) process. In other words, a top quality product will be the result of a construction process that is in control and has had all the potential causes for defects eliminated from the process. Once such a defect-free system is established it

should be adopted company wide, where appropriate, so that all crews engaged in similar work can take advantage of it (Simon, 1991). However, this again can not be done without full consideration of the situation. Often problems exist that are unique to a given location or application. Solutions to these problems should only be applied to similar situations or, where adaptable, to other situations.

Start Up Problems

Many companies experience trouble implementing the TQM philosophy. Much of this difficulty comes during the start-up phase and is due to employee disbelief and lack of support by management. If employees detect that we do not take TQM seriously they will not either. That happens when workers make viable suggestions that are not implemented and when we talk about implementation but spend all of our time on other activities. This supports the belief that you cannot motivate people to work, you can only create an environment that is going to make them want to perform better and is consistent with the Expectancy Theory of Motivation. If management does not provide this atmosphere during the implementation phase, TQM is doomed to failure.

A good example of this is the Quality Circle concept. Not many years ago, many companies embarked on the quality circle method of building quality products. The idea was that the circles of

workers would trouble shoot problems and recommend solutions. The typical circle was lead by a line manager. What happened all too often was that viable suggestions were in fact developed but management failed to act. Often free expression of ideas failed to materialize because of the power structure and inequities within the quality circle itself. The circle leaders/managers spent most of their time concerned with production issues and viewed the quality circles as a burden. Consequently, workers quickly realized that senior company management did not take quality circle seriously and lost interest in them. They simply fell by the wayside (Waddell, 1981 and Wisda & Davis, 1992). This is the very thing that Ryland suffered during their initial experience with implementing TQM.

Some of the start-up difficulty is that it is disheartening to realize there is so much room for improvement. Under the old system we simple rejected end products that failed to meet requirements (those that failed inspection) or reworked them. That was easy. TQM requires us to design defects out of the process. Once we start to examine the process as previously described, we start to appreciate just how many causes there really are for low quality. Particularly in the construction industry where each new project represents a host of new and often unique problems. Only then do we grasp the magnitude of the undertaking before us. Many companies will quit right there. They fail to realize that TQM is not a miracle drug (Ishikawa,

1985). Successful implementation of the TQM philosophy takes years of continuous hard work.

MORE DETAILS AND GUIDANCE

The following discussion is intended to provide some additional thoughts on the implementation of the TQM philosophy. The areas discussed are based on the Fourteen Points and the deadly diseases.

Focus

In order for TQM to work in a company, the company must remain focused on the long term. While it is true they must do what is needed to stay in business today, the company must look to the future and produce a product that will have markets down the road. The company must develop a reputation for high quality and customer service that surpasses the competition and keeps customers coming back. A construction company must be actively exploring ways that innovative technology can be utilized in the construction environment rather than waiting until a potential technological advantage passes them by. Japanese construction companies are actively pursuing the use of computer simulation and robotics for their work while little has been accomplished in the U.S. along those lines.

One management tool utilized by many companies that hampers the ability to focus on long term goals is the annual performance appraisal system. It focuses on short term goals and individual performance. Workers learn what is necessary to maintain their rating and have no incentive to go beyond that. Top ranked workers tend to remain on top regardless of performance. Performance appraisals may lead to individual recognition when, most often, many people have contributed to the effort. TQM calls for the implementation of a new rating system. One that focuses on the long term goal, recognizes the contributions of all employees, as well as the imperfections in the productive process itself.

Continual Improvement

As mentioned previously, TQM involves continual improvement forever. This causes a chain reaction. As we improve the process, we make fewer mistakes, there is less waste, we improve the quality, costs go down, we tighten the control limits and continue to improve the process (Walton, 1986). Continual improvement focuses on what went wrong when a problem occurs, rather than who did it. We should not be interested in placing blame, but rather in correcting the cause so that the problem does not happen again.

TQM is a continuous process. We cannot adopt TQM methods only when we need them, nor can we drop them and revert to the old way

of fighting fires when times get tough. Even though we make substantial strides toward improved quality, it is never "good enough". We might say 99.9% defect free is acceptable quality until we realize that a 99.9% standard would leave us without electricity for nine hours per year, two unsafe landings per day at O'Hare Airport, or 22,000 checks deducted from the wrong bank accounts each hour (Simon, 1991). The belief is that current performance can always be improved upon no matter how good it already is. Once we meet our current goal, we set an even higher standard and start to work toward that goal (Sproles, 1990). We will never reach perfection but we will continually try.

Utilize Worker Knowledge

One of the primary guiding principles of TQM is that employees want to do a good job. The employees of a company are their source of strength. Field workers have the construction experience and usually know how to do the work better. Much like a ship at sea that would go dead in the water without the crew, so too would a construction company cease to operate without the skilled tradesmen. Many company officers do not know the first thing about placing formwork. How then can they effectively solve formwork problems?

TQM stresses a management philosophy that nurtures human resources and shows a respect for humanity. We must go beyond viewing workers as simply a pair of hands by trying to win their

minds and hearts. Gone are the days when the Taylor Method of Scientific Management can be considered for the construction industry. Taylor did not recognize the hidden potential that all workers possess. His method ignored humanity and treated workers like machines. When this happens in practice today, work becomes uninteresting and unsatisfying. Absenteeism and turnover increases and moral decreases (Ishikawa, 1985).

We can begin to encourage and harness worker "intrapreneurism", the independent entrepreneurial spirit, of employees through empowerment. We empower workers by tapping into their knowledge for improvement and executing their suggestions (Greenwald, 1992). We encourage them to think for themselves and to discover better ways to perform the work. This is a shift from the top-down management approach which may be unsettling for middle managers. Managers may resist this action because they view it as a threat to their security. We must realize we are working together with the tradesmen to increase our competitive position in the marketplace. To be effective, the company needs to remove barriers to full employee utilization.

One effective method of increasing employee involvement and tapping into the workers knowledge and skill is through the establishment of management teams. Teams are set up at each level in the construction organization from the crew level to top management. The team leaders for a particular team can

themselves be members of teams at the next higher level. This forms a network of interlocking teams that are responsible for improving the operations over which they have responsibility (Sproles, 1990).

A construction organization may have up to three different types of teams. The first is an organizational team which is made up of individuals who have similar jobs. The masons on a given project may form this type of team. The second is a process team which is made up of workers with different skills but who are working on the same process. An example of this type of team might include the carpenters, laborers, masons, and rebar workers on a concrete crew. The third type is a task force or problem solving team. These teams are established on an as-needed basis to focus on a specific problem, and make recommendations for improvement. Once the assignment is completed, the team is typically disbanded (Sproles, 1990).

Working With Suppliers

The basic tenant behind working with your supplier is that you can not build a top quality product with defective materials no matter how hard you try. The quality of the finish product is only as good as the quality of the materials that are used to build it. It is the suppliers responsibility for the assurance of quality that will give satisfaction to the customer. To obtain continued high quality from our suppliers we must work

with them. They need to understand what we need. It is our responsibility to provide the supplier with clear and detailed information regarding our material requirements so that he or she can know precisely what to manufacture. This means more than just giving them a copy of the specifications. Just like we have customers who have specific needs, we are the customer of our supplier. In both cases the customer and supplier must agree on the meaning of quality and how it will be determined beforehand. (Ishikawa, 1985).

One of the biggest steps we can make is to begin quality control education of our subcontractors and suppliers. We work with them for continual improvement of material quality while we also work toward one or few suppliers. Only through nurturing of the relationship with one or two suppliers can we hope to maintain the quality and service that we require. Just because we, as the Prime Contractor, are often required to work in the competitive bidding environment does not mean that we have to treat our suppliers likewise. If we instead choose suppliers and subcontractors on the basis of quality, service, and price, we can possibly prevent defective work later on that may require rework and increase project costs (Sugg, 1991).

Ryland, in many cases, provides exclusive contracts with subcontractors and suppliers. For instance, they may contract with one subcontractor to construct all the foundations in a

giving geographic area for a period of three years. As part of the contract, the subcontractor or supplier must become actively involved in Ryland's quality process. Such involvement includes internal quality improvement, participating in Ryland's quality training program, and participating in Ryland's quality improvement process. Selection of contractors for such exclusive relationships is partially based on the subcontractor's internal quality activities like those listed below.

As a guide for selecting and maintaining a relationship with a supplier we should consider the following points (Ishikawa, 1985):

1. Does the supplier know our TQM management system?
2. Does the supplier has a stable management system that is well respected by others?
3. Does the supplier maintains high technical standards?
4. Can the supplier deliver those materials required?
5. Does the supplier have the ability to control the amount of production to meet delivery requirements?
6. Is there any danger of the supplier breaching corporate secrets?
7. The price is right and the delivery date can be met precisely.
8. The supplier is sincere in meeting contract provisions.

Focus on Customer

As mentioned previously, the customer is the most important part of our business. His or her satisfaction is instrumental to our success. What many fail to realize is that we have not only the

traditional customer, those outside the company, but also internal customers. The first of those is the one that buys our finished product. To meet the needs of those customers, which is essential if we hope to have them return, we must find out what they think is right or wrong with what we do.

However, to use them as our quality control system is the wrong approach. More often than not they will let us know of their dissatisfaction with their money. They simply will not buy from us again and we might not even know they are gone or why (Pouskouleli, 1991). In the construction industry one lost job could represent a loss of thousands to hundreds of millions of dollars in gross revenues. Worse yet, a dissatisfied owner may tell his friends and associates about his dissatisfaction with our product. The result would be a potential multiplication of our missed opportunities. We therefore should treat the end customer as the most important part of our production process. We must make sure we know what the customer wants before we build it and the customer knows what he wants when ordering. We must always be keenly attentive to the owners requirements, and must anticipate the opinions of the owner as we establish our own construction standards.

The second type of customer is the internal one. Every person who performs value added work has a customer. Here a good definition of customer is the person who is next in the chain of

work development that must take the previous person's output and add value to it to produce a product for their customer (Sproles, 1990). This emphasizes the supplier/customer chain relationship of value added work. Work comes to one person from the person ahead of him or from the preceding process. His or her task is to add his work and then transmit it to the person following him. The next process is our customer (Ishikawa, 1985). Just like with material supplied by an external firm, an individual in the production chain cannot build high quality into his portion of the work if he was supplied with defective materials to work with. Understanding of this relationship ensures that everyone becomes geared toward the "customers" requirements. Whether we are speaking of internal or external customers, it is most important that we direct much of our efforts to listening to, understanding, and exceeding their requirements (Allbregtse, Hejka, & McNeley, 1991).

As stated previously, Ryland focuses on value added for the external customer only. Their belief is that process or product improvements that add value for the customer will necessarily cause improvements in the internal supplier/customer chain relationship. But perhaps more importantly, focusing on the external customer creates increased customer awareness by employees and increased customer satisfaction that leads to a better reputation and ultimately more business.

Dealing With Complaints

Equally as important as the quality of the product itself is the quality of service that the customer receives. One area where service is particularly important is dealing with a customer's dissatisfaction. How does the company respond to a complaint? Here the attitude and direction of top management is essential. The guiding principle of all employees regarding customer complaints must be to resolve the problem quickly and with good faith. Defective material or products must cheerfully be replaced immediately to keep the customer happy. Perhaps more importantly, the cause of the complaint or defective product must be determined so that it will not happen again. We must correct the cause of the complaint rather than just fix the complaint.

CONCLUSION

A commercial construction company can no more stand still, in their development, than can any other type of service or supply company. To do so means they will fall behind their competitors. Just as companies upgrade their equipment to new and more efficient models, and adopt new technologies, so too must they change their management style to better meet the needs of their customer. The Total Quality Management philosophy is the only management style which focuses on high quality and ever-increasing customer satisfaction through employee involvement and continuous process improvement.

Appendix a.

SELF-AUDIT CHECKLIST

1. Leadership

a) Are senior executives personally involved in:
Goal Setting?___
Planning?___
Reviewing quarterly plans?___
Recognizing and rewarding successes?___
Meeting with customers' suppliers?___

b) Does the organization:
Have a written set of values?___
Communicate values throughout the organization?___
Have evidence that values have been adopted (surveys, data, etc.)?___

c) Do strategies exist to:
Involve all levels of management on quality improvement?___
Promote cooperation among units?___
Review quality plans and assist units that are not performing according to plan?___

2. Information and Analysis

a) Scope and types of data that exist for:
Customers___
Internal process___
Employees___
Health and safety___
Benchmark___
Quality results___
Supplier quality___

b) Data analysis
Does analysis support key objectives?___
Does analysis lead to changes in types of data collection?___
Is data readily accessible to those who need it?___

3. Strategic Quality Planning

a) Data used in planning includes:
Customer requirements___
Prices capability___
Competitive/benchmark data___
Supplier data___

b) Contributors to planning:
Employees___
Suppliers___
Customers___

c) Planning process is:
Systematically evaluated and improved___

d) Implementation:
-Projects Implemented___
-Resources Committed___
-Requirements deployed to work units and suppliers___

4. Human Resource Utilization

a) Human resource management:
-Plans integrated with quality requirements of business plans ___
-Key strategies exist for increasing the involvement and effectiveness of all employees___
-Employee-related data used to evaluate and improve human resource management___

b) Employee Involvement:
Teams exist:
Functional units___
Cross-functional___
Customer___
Strategies exist for:
Empowerment___
Innovation___
Increased employee responsibilities___

c) Quality education and training:
-Strategies exist for determining training requirements by category of employees___
-Knowledge and skills are reinforced___
-Training is evaluated for effectiveness__

d) Employee recognition:
-Key strategies exist for recognizing groups and individuals___
-Recognition reinforces quality___

e) Employee well-being and moral:
-Health, safety, and employee satisfaction are included in quality improvement activities___
-Underlying causes of accidents or dissatisfaction are analyzed___

5. Quality Assurance of Product and Services

a) Design and introduction of quality products and services:
-Customer requirements are converted into product/process requirements___

-Control plans exist for:
Key product processes___
Key services processes___

b) Process and quality control:
-Strategies exist to ensure that processes are adequately controlled___
-Focus is on identifying root causes of process upsets___
-Statistical thinking and analysis are used in process control and improvement__

c) Continuous improvement of processes, products, and services:
-Approaches include:
-Evaluation of process steps___
-Assessment of alternative processes___
-Evaluation of new technology___
-Use of benchmark data___
-Continuous improvement process is integrated with daily operations___

d) Quality assurance and quality improvements of suppliers
-Prices exists to assure that suppliers meet quality requirements___
-Strategies exist to improve the quality and responsibilities of suppliers___

6. Quality Results

a) Quality of products and services

-Key product and service measures show improvement___
-Comparisons are made with industry world leaders___
-Key quality measures in place for business processes, operations, and supplier services___

b) Supplier quality
-Key measures in place for supplier quality___
-Suppliers demonstrate quality improvement_

7. Customer Satisfaction

a) Knowledge of customer requirements
-Process for identifying customers___
-Prices for identifying products and service quality features to meet customers needs___
-Process to ensure that requirements are known throughout the company___
-Follow up to determine customer satisfaction___

-Well-defined objective measure of customer satisfaction are in place___

b) Complaint resolution
-Process exists to ensure that customer complaints are evaluated and acted upon__

-Complaints are handled properly___

c) Customer satisfaction determination
-Customer satisfaction information is used on quality improvement___
-Process exists to evaluate customer satisfaction___

Appendix b. References

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